PROGRESS REPORT

WINDFALL DAMAGE AND SUBSEQUENT INSECT INFESTATIONS

MONO LAKE-OWENS RIVER WORKING CIRCLE

BY

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E N T O M O L O G I S T

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TABLE OF CONTENTS

Summary of Preceding Reports

The area within this working circle, where heavy windfall damage occurred in February 1923, has been under observation by the Bureau of Entomology and the Forest Service since 1924. The object of this study was to determine the extent and character of subsequent insect damage to standing timber on and around areas where the windthrown trees occurred. Field examinations were made in July 1924, July 1925, September 1926 and September 1927. The Forest Service cooperated in this study by contributing from District funds to the field expenses of Bureau of Entomology representatives, and very effective help was given locally by Forest Supervisor Beothe and Ranger H.H. Simpson. During the last examination strip surveys were run by Simpson and Miller as a basis for estimates, both of the windfall and of subsequent insect damage.

The first report, submitted in October 1926 by the writer, covered the data that had been collected up to October 1926. The main points brought out in this report, dated October 28, 1926, were the following:

1. The volume of timber blown down in February 1923 was estimated at twelve and one-half million board feet on an area of 32,000 acres. Approximately half of this loss occurred on small areas of very heavy windthrow, totaling 2640 acres, where from 20 to 50 per cent of the entire stand was blown down.

2. Barkbeetles, mainly Ips, began breeding in this windthrown material during the season of 1923, but only a small percentage of the down trees were attacked.

3. No damage to standing trees on or around windfalls appeared until the fall of 1924. In August and September of that year thousands of trees above pole size were top-killed by Ips oregoni, and large groups of small trees were entirely killed by the same barkbeetle. This damage occurred on or near the areas of heaviest windfall.

4. The Ips epidemic in standing trees was limited entirely to the 1924 season, no attacks of importance occurring anywhere on the area in 1925.

5. The Jeffrey pine beetle confined its attacks mainly to the under side of windthrown trees during the seasons of 1923 and 1924. In 1925 many attacks occurred in standing trees previously top-killed by Ips. The total barkbeetle loss for the seasons of 1924 and 1925 was estimated at six million board feet.

6. During 1926 a very decided increase of Jeffrey pine beetle infestation appeared in standing trees. It was estimated that this would average over 100 trees per timbered section. This loss was widely distributed throughout the stand, and not localized around the windfalls.

7. Control measures did not appear to be feasible and were not recommended, because of inaccessibility, lack of facilities for utilization and other conditions peculiar to this area. Prompt salvage of the windthrown logs was suggested as a means of preventing similar insect outbreaks in like situations.

Examinations Subsequent to September 1926

During the latter part of October 1926 Supervisor Boothe, with Rangers Simpson, McMurphy and Way, selected and marked all insect-killed trees on a sample section near Mammoth.

The area selected was the E½ of Sec. 11 and the W½ of Sec. 12, T 3 S, R 27 E, M.D.M. It is fairly representative of the more mature type of Jeffrey pine, with some white fir on better sites. About 160 acres or 25 per cent of the section is non-timbered, with open sage brush cover.

The trees marked in the first cruise consisted of all recent loss still standing that was killed by insects during the seasons 1923 to 1926 inclusive. The 1926 loss, however, was incomplete, as a number of trees attacked late in the season were still green and could not be distinguished. A record of all windthrown trees on the area was also kept.

A second cruise of this check section was made September 15 to 20, 1927, by Miller and Simpson. In this examination all of the 1926 trees previously marked that could be located were re-examined, the 1926 trees missed in the first cruise were marked, and such trees of the 1927 attack as could be located were marked.

In addition to the cruise of this section, some time was spent in looking over other parts of the windfall area to see if recent developments were comparable to those on the check area.

Annual Loss on Check Section by Years

Year and Symbol	No. Trees	Volume
G-1923 & previous	120	335,395
H-1924	52	138,885
I-1925	40	125,580
J-1926	106	214,740
K-1927(incomplete)	4	12,900

Of the 106 trees representing the 1926 loss, 77 or about 75 per cent were located during the cruise in October 1926. The remainder were found in September 1927.

Estimates for Total Area - 1923-1926

In the first report no estimate of insect losses was made for the season of 1926, as the attack for the season was not complete at the time of the 1926 examination. An estimate was made for 1924 and 1925, based upon strip cruises in and around the windfall areas. It was impracticable to separate the 1925 from the 1924 attack, due to the combination of top-killing by Ips one season and subsequent attack by Dendroctonus the next.

The Dendroctonus attack of 1926 did not concentrate around the heavy windfalls, but was pretty generally distributed throughout the working circle. It is considered that the ratio of 1926 trees on the check section is a fair index of losses for that year throughout the area. Allowing for the 8 trees that successfully resisted attack, we have a total of 98 trees killed, or.15 tree per acre. Applying this loss to the 32,000 acres of the working circle, we have a loss of 4800 trees. However, it is doubtful if this loss will average 2000 board feet per tree, as it did on the check section, though an average of 1500 board feet per tree seems conservative. Assuming this average, the 1926 loss would total a volume of 7,200,000 board feet.

A summary of losses, starting with the windfall of 1923, would therefore stand as follows:

	No.Trees	Volume
Volume of timber blown down February 1923	--	12,565,000 bd.ft.
Standing timber killed by barkbeetles, seasons of 1924 and 1925	7500	6,000,000 "
Standing timber killed by insects, season of 1926	4800	7,200,000 "
Total		25,765,000 "

This volume will probably cover the major losses resulting from this windfall, as all evidence now points to a return of normal endemic tendencies of barkbeetle infestations within the area.

Evidence of Decline During 1927

The most striking phase of the loss figures for this check section is the very sudden drop in the number of trees killed during the 1927 season. The figures for this season are of course incomplete, as not all of the trees attacked can be located until 1928. However, it is practically certain that the loss for 1928 cannot be greatly augmented; even if it is found that the total seasonal loss is three times that already marked, the figures will not exceed 36,000 board feet. The general drop in the annual volume of infested timber from 1926 to 1927 will probably be around 85 per cent.

From observations elsewhere this same tendency seems to apply throughout the Jeffrey pine stand within the working circle. A few groups were found, especially in smaller trees, where the beetles were still making an aggressive attack. But wherever heavy losses occurred in 1926 there is a striking absence of 1927 attacks. This condition indicates that the Jeffrey pine beetle epidemic that started in 1925 has already run its course, and it can now be expected that this infestation will fall into an endemic status, characteristic of Jeffrey pine stands.

Probable Causes of Decline

In the second cruise of the check section in September 1927 an examination was made of the base of the 1926-attacked trees to see if a successful emergence of new beetles had developed from these trees. The following is a summary of the notes from 87 trees in which a successful attack had been established:

Trees showing no emergence	32
" slight "	29
" fair to heavy "	26
Total	87

Thus it is apparent that in 70 per cent of the trees the number of beetles emerging was very light, and it is doubtful if the emergence equaled the attack in numbers.

The true causes for this high mortality of broods cannot be assigned without detailed study. However, certain causes are quite apparent, even from general observations. The work of roundheaded borers under the bark during the development of the barkbeetle broods seems to have been a very strong contributing factor in bringing about the mortality of the latter. Several undetermined species of cerambycid borers multiplied in great numbers in the windthrown material, and these readily followed the attacks of D. jeffreyi in standing trees, so that their larvae came into competition with the barkbeetle broods for food supply in the inner bark. As a result, many of the Jeffrey beetle broods were starved before they could reach maturity.

Resistance of Standing Trees to Barkbeetle Attack

Out of the 77 "J" trees marked in 1926, 7 were found to be still alive in September 1927. These were trees first marked on the evidence of pitch tubes only, that succeeded later in throwing off the attack by a vigorous pitch flow. Other trees were also noted during the examination that were covered with old pitch tubes and had successfully repelled attacks prior to 1926 (see Photo No. 1). This result was due to the resistance of the more vigorous trees attacked, which culminated in the drowning out by pitch flow of the adult beetles and the complete mortality of both the parent beetles and their potential broods. The resistance of trees of this character apparently had much to do with reducing the number of beetles in the area and holding epidemic conditions in check (see Photo. No.1).

Growth conditions are apparently quite uniform in the Jeffrey pine site, and show very little of the variation characteristic of yellow pine on the west side of the Sierras. The following are measurements (mm.) from 5 green trees selected to show the growth pattern of the past ten years:

	DBH	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926
Tree No.1	34"	.40	.48	.34	.32	.25	.27	.43	.28	.23	.27
" 2	36"	.64	.60	.80	.56	.54	.78	.75	1.09	.82	.65
" 3	24"	1.36	1.25	.92	1.00	.92	1.15	1.49	1.35	1.12	1.31
" 4	40"	.41	.50	.45	.40	.40	.42	.64	.30	.24	.45
" 5	36"	.64	.67	.42	.30	.33	.54	.45	.26	.24	.37
" 6	28"	1.25	1.35	1.65	1.00	1.82	1.58	1.82	.91	1.09	1.30
Average		.78	.99	.79	.61	.71	.76	.93	.70	.62	.72

The 1923 ring indicates the most favorable season during this period; the three succeeding years (1924, 1925 and 1926) compare favorably with the three preceding seasons (1920, 1921 and 1922). The drought of 1924 apparently did not register in these Jeffrey pine areas, as the ring for that season compares well with other years and is somewhat better than that of 1925.

It would appear from the uniformity of annual rings that drought conditions had little to do with the flare-up of Ips beetles in 1924, and it is doubtful if climatic influences had much to do with the Jeffrey pine beetle epidemic in 1926. Apparently the barkbeetle epidemics were due to the breeding up of numbers in the windthrown trees, but when the beetles were forced to attack standing trees the epidemic soon lost its momentum. Natural resistance of the trees was an important factor in bringing about this result.

Further Data to be Secured

The study pertaining to this windfall situation has been limited to a determination of the general tendencies, and no attempt has been made at a detailed quantitative analysis of conditions. The data will therefore be practically complete as soon as we know definitely the extent of the decline of barkbeetle infestation in 1927.

This can be determined by a re-cruise of the check section in 1928 and general observations over the area.

General Summary

1. Heavy windfall damage which occurred in February 1923 within the Mono Lake-Owens River working circle was followed by barkbeetle epidemics in standing timber on and around the windfall areas.

2. The first barkbeetle outbreak was due to Ips oregonis. The attack in standing trees did not develop until 1924, toward the close of the second season following the windfall. This infestation was localized near points where heavy wind damage occurred, and had entirely subsided by the late summer of 1925.

3. Dendroctonus jeffreyi attacked to a limited extent the under side of down green logs in the windfalls. It began to attack standing trees in numbers in 1926. In 1926 the infestation of this barkbeetle was in the epidemic stage, averaging over 100 trees per section. This loss was generally distributed throughout the stand and was not localized near windfalls.

4. All evidence indicates that barkbeetle infestations had subsided to an endemic condition during the 1927 season. The 1927 losses in standing trees are estimated to be but 15 per cent of those that occurred in 1926.

5. Growth conditions indicate that the barkbeetle epidemics in standing timber were not due to climatic factors, but were caused by beetles coming out of the windfalls, where their numbers had greatly increased because of the favorable breeding conditions in weakened, windthrown trees.

6. The decline of the epidemic situations appears to have been due to some extent to resistance of vigorous trees to barkbeetle attacks. In the case of the Jeffrey pine beetle, competition of roundheaded borers with barkbeetle broods for the food supply of the inner bark caused a very high mortality of broods developing from the 1926 attacks.

7. Control measures against the barkbeetle situation were considered impracticable for this area, due to inaccessibility and low values of the timber. When similar situations arise, under conditions where utilization of the timber is possible, prompt salvage of the windthrown trees by logging them out of the area would afford an obvious method of preventing subsequent insect damage to standing timber. Control work against barkbeetle broods in the windfalls is also to be considered. It is doubtful, however, if control work is warranted after the beetles go into standing timber, as this study, together with the one carried out on the California National Forest in 1922-1923, has shown that barkbeetle epidemics developing from windfall situations are shortlived and soon die down in standing timber.

PHOTO NO. 1

Cross section showing bark and sapwood of 54" tree which successfully resisted an attack by the Jeffrey pine beetle on the Mammoth check area. The attack occurred during the season of 1924. The 1924 ring was partially suppressed, as was also the 1925 ring, as a result of the injury caused by the egg galleries in the cambium layer. In 1926 and 1927 the tree had apparently recovered its normal growing vigor, and began rapidly to heal over the scars. No broods developed successfully from this attack, and the parent adults were forced out of the tree by the vigorous sap flow, which was built into conspicuous pitch tubes.

A. Pitch tube formed on outer bark by parent beetles in combating sap flow.

B. Scar of egg gallery formed on surface of the 1924 ring. The dark areas in sapwood around these scars are due to heavy infiltration of resin in the wood.

Photo by J.M. Miller, Sept.20,1927.

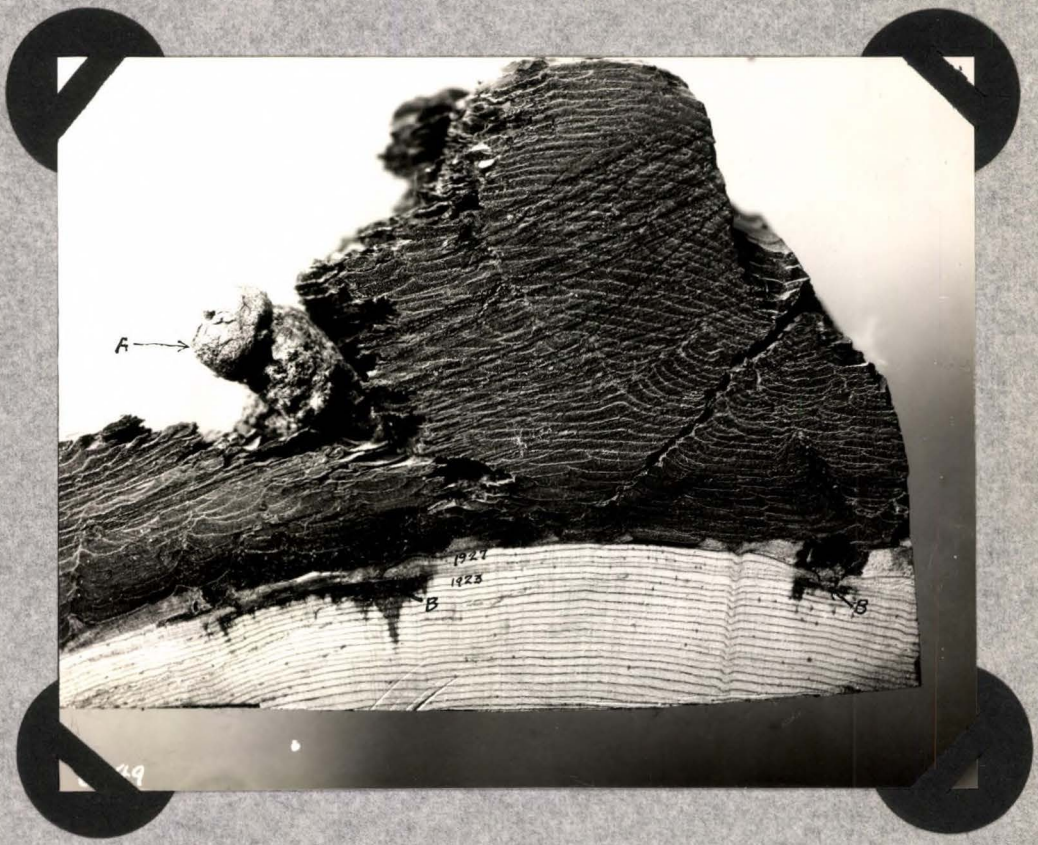

PHOTO NO. 1

PHOTO NO. 2

Area just north of Big Spring on Deadman Creek, showing trees of 1926 attack. These trees have sorrel and red foliage, but appear as white tops in prints from panchromatic negatives. The loss of this season was widely distributed throughout the stand without reference to location of areas where heavy windfall damage occurred.

Photo by J.M. Miller, Sept.20,1927.